

Attorney's ~~Socket~~ No.: 09695-004001

Application No. 09/813,445

Amendment dated December 10, 2003

Reply to Office action of March 31, 2003

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended): A fiber device, comprising:
 - a sleeve having an elongated tubular body with an input terminal and an output terminal;
 - an input fiber ferrule placed in said sleeve at said input terminal;
 - a plurality of pump fibers bundled together at one fiber terminals by said input fiber ferrule to form a pump fiber bundle, wherein end facets of said bundled fiber terminals are polished to form an optical pump coupling surface for outputting pump light from said pump fibers;
 - a plurality of lasers respectively coupled to said pump fibers to produce light into each pump fiber;
 - an output fiber ferrule placed in said sleeve at said output terminal;
 - a double-clad fiber having a fiber core, an inner cladding layer surrounding said fiber core, and an outer cladding layer surrounding said inner cladding layer, said double-clad fiber further including a pump-receiving terminal coupled to said output fiber ferrule to receive said pump light into said inner cladding layer, wherein said double-clad fiber includes a fiber loop in which said fiber core is doped with active ions to produce optical gain; and
 - a lens disposed in said sleeve between said input and said output fiber ferrules to image said optical pump coupling

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surface onto said pump-receiving terminal, wherein said lens has a numerical aperture not greater than a numerical aperture of said inner cladding layer;

a first set of wavelength-selective reflectors formed in said double-clad fiber between said pump-receiving terminal and said fiber loop, each reflector operable to reflect light at a selected wavelength while transmitting light at other wavelengths; and

a second set of wavelength-selective reflectors formed in said double-clad fiber on a side of said fiber loop opposite to said first set of wavelength-selective reflectors, each reflector operable to reflect light at a selected wavelength while transmitting light at other wavelengths.

2. (previously presented): The device as in claim 1, wherein said pump-receiving terminal has an end facet that forms an acute angle with respect to a plane perpendicular to a longitudinal direction of said double-clad fiber.

3. (previously presented): The device as in claim 2, wherein said lens includes an optical output surface facing said pump-receiving terminal which is substantially parallel to said end facet of said pump-receiving terminal.

4. (previously presented): The device as in claim 1, wherein a center of said pump fibers, a center of said lens, and said fiber core of said double-clad fiber are substantially aligned along an optic axis of said lens.

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5. (previously presented): The device as in claim 1, wherein exteriors of said input and said output fiber ferrules, and said lens conform to an interior of said sleeve.

6. (previously presented): The device as in claim 1, wherein said lens includes a GRIN lens.

7. (previously presented): The device as in claim 1, wherein said lens is configured to couple said pump light to said pump-receiving terminal with a beam spot not greater than a spatial extent of said inner cladding layer.

8. (previously presented): The device as in claim 1, wherein said sleeve includes a slit formed from said input terminal to said output terminal along a longitudinal direction of said sleeve.

9. (previously presented): The device as in claim 1, wherein said sleeve is formed of Zirconia or Phosphor Bronze.

10. (previously presented): The device as in claim 1, wherein each fiber ferrule includes a glass, quartz, a metal, or a ceramic.

11 - 13 (Canceled)

14. (currently amended): A fiber device, comprising:
a sleeve having an elongated tubular body with an input
terminal and an output terminal;

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an input fiber ferrule placed in said sleeve at said input terminal;

a plurality of pump fibers bundled together at one fiber terminals by said input fiber ferrule to form a pump fiber bundle, wherein end facets of said bundled fiber terminals are polished to form an optical pump coupling surface for outputting pump light from said pump fibers;

a plurality of lasers respectively coupled to said pump fibers to produce light into each pump fiber;

an output fiber ferrule placed in said sleeve at said output terminal;

a double-clad fiber having a fiber core, an inner cladding layer surrounding said fiber core, and an outer cladding layer surrounding said inner cladding layer, said double-clad fiber further including a pump-receiving terminal coupled to said output fiber ferrule to receive said pump light into said inner cladding layer, wherein said double-clad fiber includes a fiber loop in which said fiber core is doped with active ions to produce optical gain;

a lens disposed in said sleeve between said input and said output fiber ferrules to image said optical pump coupling surface onto said pump-receiving terminal, wherein said lens has a numerical aperture not greater than a numerical aperture of said inner cladding layer;

~~The device as in claim 12, further comprising:~~

a first set of wavelength-selective reflectors formed in said double-clad fiber between said pump-receiving terminal and said fiber loop, each reflector operable to reflect light at a selected wavelength while transmitting light at other wavelengths;

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a broadband reflector formed in said double-clad fiber on a side of said fiber loop opposite to said first set of wavelength-selective reflectors and operable to reflect each selected wavelength of each reflector in said first set of wavelength-selective reflectors; and

an optical coupler coupled between said broadband reflector and said fiber loop to produce an optical output at a selected laser wavelength.

15. (currently amended): A fiber device, comprising:

a sleeve having an elongated tubular body with a cylindrical interior;

an input fiber ferrule having a cylindrical exterior substantially conforming to said cylindrical interior of said sleeve and placed within said sleeve;

a plurality of pump fibers having fiber terminals bundled together by said input fiber ferrule to form a pump fiber bundle to deliver pump light into said sleeve;

an output fiber ferrule having a cylindrical exterior substantially conforming to said cylindrical interior of said sleeve and placed within said sleeve and spaced from said input fiber ferrule;

a double-clad fiber having a fiber core, an inner cladding layer surrounding said fiber core, and an outer cladding layer surrounding said inner cladding layer, and engaged to said output fiber ferrule to receive said pump light into said inner cladding layer; and

a lens disposed in said sleeve between said input and said output fiber ferrules to have a lens optic axis substantially aligned with a center of said pump fibers and said

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fiber core of said double-clad fiber, wherein said lens has a numerical aperture not greater than a numerical aperture of said inner cladding layer and said lens is spaced from said input and said output fiber ferrules to image end facets of said pump fibers to an end facet of said double-clad fiber.

16. (Canceled)

17. (previously presented): The device as in claim 15, wherein said lens has an output lens surface facing said output fiber ferrule that is parallel to an end facet of said double-clad fiber, wherein both said output lens surface and said end facet form an acute angle with respect to a plane substantially perpendicular to said lens optic axis.

18 - 20 (Canceled)

Please add new claims:

21. (new): The device as in claim 14, wherein said pump-receiving terminal has an end facet that forms an acute angle with respect to a plane perpendicular to a longitudinal direction of said double-clad fiber.

22. (new): The device as in claim 21, wherein said lens includes an optical output surface facing said pump-receiving terminal which is substantially parallel to said end facet of said pump-receiving terminal.

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23. (new): The device as in claim 14, wherein said lens includes a GRIN lens.

24. (new): The device as in claim 14, wherein said lens is configured to couple said pump light to said pump-receiving terminal with a beam spot not greater than a spatial extent of said inner cladding layer.

25. (new): The device as in claim 14, wherein said sleeve includes a slit formed from said input terminal to said output terminal along a longitudinal direction of said sleeve.

26. (new): The device as in claim 14, wherein said sleeve includes a material of Zirconia or Phosphor Bronze.

27. (new): The device as in claim 14, wherein each fiber ferrule includes one material selected from a group consisting of a glass, quartz, a metal, and a ceramic.

28. (new): The device as in claim 14, wherein a reflector in said first set of wavelength-selective reflectors is a fiber Bragg grating formed in said double-clad fiber.

29. (new): The device as in claim 1, wherein a reflector in said first set of wavelength-selective reflectors is a fiber Bragg grating formed in said double-clad fiber.

30. (new): The device as in claim 1, wherein a reflector in said second set of wavelength-selective reflectors is a fiber Bragg grating formed in said double-clad fiber.

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31. (new): The device as in claim 1, wherein each of said wavelength-selective reflectors in said first and said second sets is a fiber Bragg grating formed in said double-clad fiber.